DATE: 3/20/97

CONTROLLING OFFICE FOR THIS DOCUMENT IS:
SIMULATION AND TECHNOLOGY DIVISION
DIRECTORATE FOR TECHNICAL MISSION
US ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005-5055

POC: DIRECTOR

DISTRIBUTION STATEMENT A: Public release

Environmental Cost Prediction Model Under Development at YPG

Lance Vander Zyl, Larry R. Stanford, Dick Pastore

A team consisting of the U.S. Army Yuma Proving Ground (YPG) Environmental Science Office, TRW, and Walcoff & Associates is developing an Environmental Cost Prediction Model (ECPM) for testers, evaluators, and test project managers. The team is designing the model to estimate environmental costs that might be incurred with a variety of different test configurations. The model will assist in making sound decisions based on best value, logical comparisons, and in-depth assessments. The ECPM will help users consider alternatives that meet test and evaluation (T&E) requirements and, at the same time, minimize environmental costs.

Now, more than ever, efforts to predict the effects on the environment from T&E activities, and the associated cost estimates, must be expedited. Currently such costing efforts are conducted manually with little automation, and the results are often imprecise and challengeable. This project creates a transportable environmental cost prediction model for any given Major Range and Test Facility Base (MRTFB). Incorporation of user selected parameters will permit customizing of the model. The completed model will be usable on Microsoft Windows-based computer systems, with emphasis on personal computers and work stations. The ability of the computer to speed up "realtime" allows test managers to evaluate the effect of various T&E factors, conditions, parameters, and configurations on the environment. In addition, the T&E community is provided with a tool to plan test events and locations that lessen both environmental impacts and associated costs, and minimize the risk of delayed or canceled testing due to circumstances not factored into the test schedule.

The ECPM is being developed as a Test Technology Development and Demonstration (TTD&D) project. TTD&D projects are intended to facilitate the transition of mature technologies from laboratories to satisfy T&E needs. Technology projects proposed by the Services and defense agencies are reviewed by the Office of the Director, Test, Systems Engineering, and Evaluation (DTSE&E) within the Office of the Secretary of Defense (OSD). Selection of a technology project is based on its ability to test high technology systems and upgrades, broad-based applications to foster interoperability among test centers, transportability, efficiency of operation, and application at multiple Department of Defense (DOD) ranges or defense agencies.

Test technology must keep up with or exceed the high levels of technology employed by modern weapons systems while in T&E. OSD and the Services recognize the need for advanced tools for T&E and are allocating resources accordingly. New projects are selected each year through an extensive nomination and selection process.

Prime consideration is given to high payback from projects with better decisionmaking data, increased testing efficiency, greater safety, labor savings, and reduced maintenance costs. FY95 TTD&D projects are primarily in the categories of range instrumentation and test, and range architecture. Additionally, consideration is given to appropriate candidates nominated in environmental and dual-use areas. Projects selected for funding under TTD&D are expected to be available for transition to field use within 2 to 4 years from initial funding. The ECPM will be developed in five phases over an 18-month period.

Phase I

Phase I was central to the objective that the model produced will have the best potential for modification and use by the MRTFB. In phase I, the team produced a comprehensive requirements determination that ensured that the MRTFB's needs were incorporated into the ECPM. The team achieved this objective by performing research to identify those requirements imposed on the MRTFB's that affect environmental costs. The research process included the application of survey techniques, technical and legal research, and the development and maintenance of a data base to record the requirements identified.

The requirements determination was comprehensive in all ways. T&E community requirements were identified by either written or telephone interviews of appropriate MRTFB personnel. Project managers for major development programs were contacted to determine the types of future T&E activities planned and assess whether they may lead to additional environmental cost data requirements. In addition, research was undertaken to identify requirements that affect environmental costs; for example, statutory, regulatory, and policy control, and litigation concerning MRTFB or T&E community activities.

The team also prepared a Commerce Business Daily (CBD) "sources-sought synopsis" and defined user functional requirements, specifically to ensure that the technical viewpoint (i.e., hardware/software compatibility, requirements testability) was represented.

The requirements determination identified the numerous factors associated with environmental cost prediction, including site-specific considerations at the MRTFB's; the general types of test configurations used; and cost parameters driven by the objectives of compliance, pollution prevention, health and safety, and other environmental issues. The team, at all times during phase I, followed a strategy designed to produce a summary report that identified all factors associated with environmental cost prediction at the MRTFB's. Similarly, the strategy enabled identification, modification, and deployment of an ECPM that would find usage by the test managers within the MRTFB.

Phase II

During phase II, the project team produced a comprehensive list of existing environmental cost analysis and prediction models available in both the commercial and public sectors. Compilation of the inventory was aided by a review of the responses received to the "sources-sought synopsis" published in the CBD by YPG. The review process included confirming that no recognized model was excluded from identification because a potential source failed to see and respond to the CBD Notice. Interaction with the MRTFB and others within the T&E community helped to identify the capabilities of the existing models that would be pertinent to their potential application as environmental cost prediction models.

The final list of existing models was prepared from data and information provided by the MRTFB, through the responses to the CBD Notice, independent research by the project team members, and from consideration of several technical factors that were identified as critical to the installation, use, and maintainability of the models by MRTFB environmental and T&E staffs.

Always during phase II, the team followed a strategy designed to produce a meaningful list of existing cost-prediction and analysis models and to establish the basis for the development of quantifiable criteria for selection that would occur during the next phase.

Phase III

Phase III had two objectives:

- Establishment of a quantifiable list of model selection criteria and an associated scoring system for selection.

- Application of the criteria and the scoring system to recommend the best value existing model for adaptation as the ECPM for the MRTFB.

To achieve the first objective, the project team submitted the criteria and scoring system for user review and approval before using them to assess and select the best value model. The criteria included the ability of the models to meet the functional cost prediction and alternative assessment needs of the MRTFB and systems-acquisition managers, technical issues pertaining to the hosting of the models on the target platforms, and the nature and degree of particular constraints that model developers may have placed on the licensing and distribution of their products that would make adaptation difficult or expensive.

Examples of the criteria and scoring system components included defining "adaptability" in terms of an estimate of both staff hours and source lines of application code to be modified to adapt the existing model to meet MRTFB requirements, and identifying specific costs associated with and actions required to resolve issues relating to manufacturer's/distributor's licensing and/or distribution requirements. The criteria and the associated algorithm for calculating an individual model's "figure of merit" were prepared and used to summarize the application of the assessment methodology using the approved criteria. The team presented all detailed data developed during the assessment.

Immediately following identification of the candidate model, the team began phase IV and procured the model, including the related application software, compilers, and tools required to host the model on PC workstations. To minimize site-specific problems, the development of a prototype ECPM was conducted on platforms which mirror, to the greatest extent possible, the hardware and software environments of the intended PC workstations. The prototyping process, from implementation through testing, was documented in a conventional software development folder. The emphasis of the prototyping effort was on developing an open system; one that not only satisfied the user requirements established during phase I, but one that facilitated incorporation of new corporate data and the user manipulation of model parameters. The prototype cost prediction model will comprise three interrelated components:

- A cost estimate compiler application for the selected software.
- An environmental compliance action data base.
- A reports generator.

Phase IV

Consequently, phase IV includes the development of these components. Particularly important to the team's efforts was the development of the cost data base. The team's research showed that there was no comprehensive listing of environmental compliance actions that could possibly be required, at any military installation, if a specific extraordinary event _ like a weapons system test _ were to be planned for execution at that installation. Furthermore, there was not a comprehensive list of costs for implementing environmental compliance actions at the installations. Using a number of different sources obtained from all military departments, the team has compiled a listing

of more than 300 cost line items, with cost information, that will constitute the prototype cost data base. In addition, the model has been selected and designed so that users can, and are expected to, add cost line items, modify included cost line items, and alter the cost data based on their experience or data.

Phase V

Phase V will be conducted as follows. After identification of four selected MRTFB Beta test installations, a member of the team will visit each site to install the prototype ECPM, upload the corporate environmental cost data, and check out the operating model. While on site, the team member will conduct hands-on familiarization involving the cognizant range personnel, beginning with the installation process and concluding with sessions regarding prototype use. The goal of the familiarization process is to enhance the success of the testing program at the individual test sites.

Throughout a 4-month testing process, the team will operate a help desk to resolve issues, facilitate user testing, and receive problem reports. If significant operational issues arise, especially those which reduce the effectiveness of the site testing, solutions will be developed and transmitted to the individual Beta test sites.

Following completion of the site testing, the team will develop a model guide and user instruction manual. The information developed during the individual site visits and through calls to the help desk will be particularly useful to the development of the model documentation. The content and format of the user documentation will be reviewed before drafting the document. It will incorporate guidance from existing Government and civilian (e.g., ANSI/IEEE) standards. Working closely together, the team will publish the user guide and customer support documents needed for a software program that contains searchable environmental data bases. The familiarity of the team with the MRTFB and the T&E community will ensure that the expertise in producing customer support documentation will be targeted precisely toward the needs of the end user.

Along with the formal operational documentation, the team will also develop the model's software development folder; an aggregate of technical information relating to the analysis of requirements, design, implementation, and testing produced during the prototyping and site deployment cycles in phases IV and V.

The ECPM will develop a modeling and simulation process that can be used to predict the environmental costs associated with particular project tests or series of tests and represents an important investment for reducing environmental impact in testing for future weapons programs.

For more information **contact**
Lance Vander Zyl
Commercial (602) 328-2124
DSN 899-2124